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Loggers vs. Campers: Compensation for the Taking of Property Rights

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Governments often have the power to take property rights from private citizens but their responsibility to pay compensation is typically not well specified. In this paper we examine how the compensation rule adopted by a country affects both private investment decisions and takings decisions. We build on a widely accepted argument that any lump sum compensation, including zero, is the socially optimal compensation scheme. The lump sum compensation result hinges critically on the assumptions that the government maximizes social welfare and that the level of private investment does not affect the alternative use of the property rights. We find that when either of these assumptions is relaxed, the optimal compensation scheme will generally depend upon market values. The model presented here provides strong support for market value compensation for the taking of property rights in modern societies.

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> One of the major activities of modern governments is the granting of special privileges to various groups of politically influential people.
>
> Gordon Tullock (1975), *The Transitional Gains Trap*

1 Introduction

Governments have the power to take property rights away from private citizens. While such discretion can be used to increase social welfare, it can, as the quote from Tullock (1979) suggests, form the basis of a government moral hazard problem, a situation where the power to take is used primarily to benefit one group in society at the expense of another. In this paper we examine the ways in which binding compensation rules can be used to balance the costs and benefits of granting governments the power to take property when they are subject to moral hazard.

The literature that we build on has not provided much analysis of government moral hazard. In the absence of government moral hazard, a very simple, but controversial, compensation rule has been suggested: zero compensation. The intuition behind the zero compensation result, put forth an influential paper by Blume, Rubinfeld and Shapiro (1984)—henceforth BRS, is straightforward and best illustrated with a simple example. Consider an individual who wishes to build a house on a tract of land. There is a 50% chance that, at some future point in time, social welfare can be improved by the construction of a road through the property. If this happens, the house will have to be destroyed. If compensation for the expropriation is based on market value, then the individual will ignore the expropriation possibility in deciding how much to spend on the house: The individual's optimal investment level will equate private benefit to private cost independent of the probability of a loss. Since this ignores the social cost of destroying a valuable asset, an inefficiency results in that there will be overinvestment from a social perspective. On the other hand, if compensation is a lump sum that is independent of the amount spent, then expected private costs (the expected loss of the house) will reflect social costs and an efficient investment decision will be made.

The BRS zero compensation result is controversial because, in practice, courts have shown a preference for using market value as the appropriate level of compensation. And many legal and economic commentators seem to generally support this preference. For instance, Fischel and Shapiro (1988) state "If pressed on the question, most economists and lawyers would, we believe, conclude that the government should pay for the property that it takes. The argument, especially that of economists, might be that forcing the government to pay for the resources it gets promotes efficiency."[1]

In this paper we show that the noncompensation result is critically linked to the assumptions that a) there is no government moral hazard and b) private investment

[1]Fischel and Shapiro (1989) refer specifically to Baxter and Altree (1972), DeAlessi (1969) and Epstein (1985).

has no social value if property rights are taken. We show that relaxing either of these assumptions leads to a compensation rule that will depend upon market value.

For the most part, market value is shown to be important in our analysis because we consider cases where the government charged with implementing the taking decision favors particular constituencies. Although this case has received scant attention, there exists ample evidence which suggests that governments, politicians, and courts behave in this manner. For example, first state constitutions in the US did not specify any compensation for government takings because people had faith in the legislations to do the right thing, (Treanor (1985)). Later on, when faith in the legislatures to do the right thing declined, states amended their constitutions by imposing just compensation clauses. Society, it appears, believed that governments were capable of taking actions that were not in their best interests and responded by protecting themselves with compensation clauses.

One famous case where court taking discretion favored one party over another is Miller v. Schoene. Here, ornamental cedar trees were infected with a fungus that were harmless to the cedar but fatal to apple trees. The courts ordered that the cedars be felled without compensation to the owners. The courts clearly put the preferences of one group in society over another by arguing that "Apple growing is one of the principle agricultural pursuits in Virginia."[2]

Heller and Krier (1999) more generally note the extent to which discretion has been prevalent in actual taking cases: "Supreme Court decisions over the last three-quarters of a century have turned the words of the Taking Clause into a secret code that only a momentary majority of the Court is able to understand. The Justices faithfully moor their opinions to the particular terms of the Fifth amendment, but only by stretching the text beyond recognition."

It is not clear, however, whether takings decisions always favor one group in society over another. For instance, with respect to land taking decisions in the US, Carlson and Pollack (2001) note that "Since 1987, the Supreme Court has given scholars ample material to expound upon by deciding numerous takings cases, virtually all of them in favor of the property owner." On the other hand, there is concern that regulatory takings decisions will be so harmful to property owners that they will undermine infrastructure investment. As Rose-Ackerman and Rossi (2000) put it: "How does a state attract foreign investment where there is some possibility that the commitments behind its current regulatory regime may change? Like deregulation in the United States, legal, political and regulatory transitions in developing countries pose political and regulatory risks that may undermine investor confidence, at great cost to their economies."

In this paper we formally model the notion that a government favors one constituency over another and show that market value compensation can be used as an effective tool for mitigating the inefficiencies associated with such behavior. The papers in the literature that are closest to this one are Fischel and Shapiro (1989),

[2] 276 US 272 (1928). This and many other cases are discussed in Heller and Krier (1999)

Hermalin (1994), and Miceli and Segerson (1994). However, none of these papers come to the conclusion that compensation should be related to the market value of the taken property.

Fischel and Shapiro (1989) consider a situation where the government's takings decision is determined by maximizing the welfare of the majority of voters. Although they conclude that the compensation schedule will be some positive fraction of market value, they unduly restrict the form of the compensation schedule. Specifically, they rule out any form of lump sum payments.[3] When compensation is allowed to be a linear function—*with a non-zero constant*—of the market value, it can be shown that the set of first-best allocations can now be implemented and the form of the optimal compensation is a simply lump sum payment.

Hermalin's (1994) model is motivated by informational asymmetries between the government and investor. He assumes that the government takes private property only if the benefit to society exceeds the price that the government must pay for the property. With these kinds of preferences the government may end up taking private property when it is not socially optimal to do so. Hermalin's main conclusion is that "efficiency requires compensating the citizen based not on what she loses, but rather on what society gains from the taking." That is, market value compensation should *not* be used.

Finally, Miceli and Segerson (1994) consider a model where the government suffers from "fiscal illusion." A government suffers from fiscal illusion if it only considers the actual and not social costs in its decision making. Miceli and Segerson's (1994) *ex post* rule requires that the government compensate the investor at market-value only if the expropriation is not socially efficient; a socially efficient expropriation does not require compensation. Since, in equilibrium, the government does not expropriate if it is not socially efficient, compensation will be zero and, thus, independent of market-value.[4]

In the next section we set out our model. We consider the decision of a government that can remove rights to harvest timber so as to develop a wilderness park, where the right holder, the "logger," has made an earlier investment in developing the timber stand. The "campers" in society will benefit from the development of a wilderness park. In section 3, the set of first-best allocations are described. As a benchmark we analyze the case where government moral hazard is absent in section 4. In section 5, the implications of having private investment affecting the alternative value of the property is examined. Sections 6 and 7 examine the impact of government moral hazard; section 6 assumes that the government cares only about campers and section 7 assumes it only cares about loggers. Section 8 summarizes and concludes.

[3] Fishel and Shapiro's constitutional conference, where the form of the compensation schedule is determined, can be viewed as a regulation problem. The importance of fixed payments in compensation is well known in the regulation literature.

[4] In a model of a homogeneous population of investors, where one investor is "elected" to form a government, Nosal (2001) finds that market value compensation is always optimal.

2 Model

We examine the problem faced by a social planner designing a rule that will determine the amount, K, that will be paid to anyone whose property is taken. The social planner puts a compensation rule in place at date $t = 0$ and it applies to property that may be taken at date $t = 2$. The social planner is equally concerned with the welfare of two agents, a logger and a camper, and weighs equally their welfare, L and C, respectively. That is, the social planner's objective is to maximize

$$W = L + C.$$

The logger is endowed with a unit of capital and a unit of land. Capital is non-storable, perfectly divisible, and can be allocated over two production technologies, one of which requires land and one that does not. For convenience, we will refer to the technology that requires land as tree planting and the technology that does not as the safe project. Let $x \in [0, 1]$ denote the amount of capital that is allocated to tree planting. The logger makes his investment decision at date $t = 1$.

Outputs are realized at date $t = 3$. The safe project produces $g(1 - x)$, where $g' > 0$, $g'' < 0$, and $g'(y) \to \infty$ as $y \to 0$. Tree planting produces $\theta x \tau$, where θ is a stochastic productivity shock, $\tau \in \{0, 1\}$, and $\tau = 1$ means that the logger retains his property rights and $\tau = 0$ means that he does not. When the logger's property rights are taken both the investment and potential output, θx, are lost. At the same time, however, a taking produces a stochastic benefit of β to the camper; the camper gets to enjoy a wilderness park. We will refer to β as the alternative private value of the logger's land.

At $t = 1$, when the logger makes his investment decision, the values of θ, τ and β are not known. We assume that $\theta \geq 0$ is distributed according to the density $f(\theta)$, where $f(\theta) > 0 \ \forall \ \theta \in [\theta_0, \theta_1]$ and $f(\theta) = 0$ otherwise; and $\beta \geq 0$ is distributed according to the density $h(\beta)$, where $h(\beta) > 0 \ \forall \ \beta \in [\beta_0, \beta_1]$, and $h(\beta) = 0$ otherwise. These sources of uncertainty are resolved at date $t = 2$. After the true values of θ and β are revealed the government chooses τ. The takings rule, τ, is a function of productivity, θ, the alternative private value of the land, β, the level of tree planting, x, and the compensation payment, K.

When property rights are revoked the logger is paid $K(\theta x)$. We assume that $K(\theta x)$ can be committed to in that once a schedule is established in law—say, by being enshrined in a constitution—it must be followed. We will sometimes refer to θx as the "market value" of the land because if the logger's property rights were not taken the output would be sold be for θx.[5] Note that the compensation schedule is not a function of β. We believe that, although market values can be made verifiable

[5]Implicitly, we equate the logger's value of his property with the market value. Knetsch and Borcherding (1979) point out that in many instances market value may understate the value that the owner attaches to his property. An implication of this situation is that there may be excessive takings because market value does not capture the true opportunity cost of the land.

to a court of law, it would be extremely difficult, if not impossible, to verify the alternative private value. Thus, one can interpret the compensation schedule, $K(\theta x)$, as an *incomplete contract.*

For a given x, K, and τ, the expected payoff to the logger is

$$L(x; K, \tau) = \int_{\theta_0}^{\theta_1} \int_{\beta_0}^{\beta_1} \pi^l(x, s, t) h(t) f(s) dt ds$$

where

$$\pi^l(x, \theta, \beta) \equiv g(1-x) + \tau(\theta, \beta, K, x)\theta x + \big(1 - \tau(\theta, \beta, K, x)\big) K(\theta x).$$

We assume that $\beta_1 > \theta_1$; this can be interpreted to mean that for every possible private value θx, there exists an alternative private value, β, that exceeds it. We also assume that $L(x; K, \tau)$ is strictly concave in x.

The camper does not make production or investment decisions. He receives the benefit, β, from any takings decision and pays compensation K to the logger. The net expected payoff for the camper, $C(x; K, \tau)$, is given by

$$C(x; K, \tau) = \int_{\theta_0}^{\theta_1} \int_{\beta_0}^{\beta_1} \pi^c(x, s, t) h(t) f(s) dt ds$$

where

$$\pi^c(x, \theta, \beta) \equiv (1 - \tau(\theta, \beta, K, x))(\beta - K(\theta x)).$$

In practice, policy is implemented by governments who are influenced by personal and political considerations.[6] We capture this notion simply by assuming that the government cares only about either the logger or the camper. We use the term "government moral hazard" to refer to the fact that the government's preferences will not reflect the social planner's. The government's objective function is given by

$$\max_{\tau(\theta,\beta,K,x)\in\{0,1\}} \quad G_\omega(\tau; x, K) = \omega \pi^l(x, \theta, \beta) + (1-\omega)\pi^c(x, \theta, \beta), \ \omega \in \{0, 1\} \qquad (1)$$

where $\omega = 1$ if the government cares only about the logger and $\omega = 0$ if the government cares only about the camper. It may be the case that the government is indifferent between taking and retaining property rights: We therefore assume the following,

Assumption A: *In the event that the government is indifferent between taking and not taking, it will choose the action that maximizes social welfare.*

We assume for simplicity that the compensation rule is linear, $K(\theta x) = a + b\theta x$. This rule captures a combination of two compensation schemes that have been

[6]For an excellent survey and application of this approach see Grossman and Helpman (1994). See also, Laffont and Tirole (1993, Part V).

suggested in the literature: (1) a fixed payment, (i.e., $a > 0$ and $b = 0$) and (2) market value compensation (i.e., $b = 1$ and $a = 0$).[7]

The social planner's problem can be viewed as a single principal, two agent problem, where the agents are the logger and the 'ω-type' government. Formally, the planner's problem is,

$$\max_{\{x,K,\{\tau(\theta,\beta,K,x)\}\}} W(x,K,\tau) = L(x;K,\tau) + C(x;K,\tau) \tag{2}$$

subject to

$$L(x;K,\tau) \geq L(\tilde{x};K,\tau) \quad \forall\ \tilde{x} \in [0,1] \tag{3}$$

and $\forall\ \beta \in [\beta_0, \beta_1]$ and $\forall\ \theta \in [\theta_0, \theta_1]$

$$G_\omega(\tau;x,K) \geq G_\omega(\tilde{\tau};x,K), \quad \forall\ \tilde{\tau} \in \{0,1\}. \tag{4}$$

The constraints (3) and (4) represent the incentive constraints for the logger and the government, respectively. We will refer to $\langle$(2),(3),(4)$\rangle$ as the *constrained planner's problem.*

Up to this point we have assumed that the alternative private value of the land is independent of the level of investment in tree planting. It is not difficult, however, to think of examples where the level of private investment affects the alternative value of the asset. For example, when logging firms invest in cultivation and reforestation, they enhance value of the land in the event that land is taken and converted into a park. In contrast, private investment can have a negative impact on its alternative value if, for instance, it causes environmental damage. In section 5, we will model this phenomenon and examine how it affects the optimal compensation rule.

We will conclude this section by reviewing the timing of the model. At date $t = 0$ the social planner establishes the compensation rule. At date $t = 1$ the logger makes his investment decision. Uncertainty with regard to θ and β is resolved at date 2 and the government makes its takings decision. At date 3 output is produced and distributed.

3 First-Best Allocation

As a benchmark, we characterize the first-best allocation, which is defined by letting the planner make both the taking and investment decisions. The planner chooses a level of investment $x \in [0,1]$ and function $m\colon [\theta_0, \theta_1] \to [\beta_0, \beta_1]$ that determines the taking decision. Specifically, the social planner will choose x and m so as to maximize the social welfare function,

$$\int_{\theta_0}^{\theta_1} \int_{\beta_0}^{m(s)} sxh(t)f(s)dtds + \int_{\theta_0}^{\theta_1} \int_{m(s)}^{\beta_1} th(t)f(s)dtds + g(1-x).$$

[7] Non-linear compensation schemes will mirror our results but will do so at the cost of significantly complicating the analysis.

We assume that this function is strictly concave in x and $m(s)$. It is straightforward to show that the optimal taking decision is given by

$$\left.\begin{array}{l}\text{Take}\\ \text{Do not take}\end{array}\right\} \text{ if } \left\{\begin{array}{l}\beta > \theta x\\ \beta \leq \theta x\end{array}\right., \tag{5}$$

and that the optimal level of private investment is determined by the equality of the expected marginal productivity of the risky technology and the marginal productivity of the risk-free investment, i.e., x is determined by

$$\int_{\theta_0}^{\theta_1}\int_{\beta_0}^{sx} sh(t)f(s)dtds - g'(1-x) = 0. \tag{6}$$

Denote the solution to (6) as x^*.

4 No Government Moral Hazard

Although we believe that one can not fully understand compensation practices for takings without explicitly considering the existence of government moral hazard, in this section we assume that it does not exist. We do so in order to demonstrate that our model is a "standard one" in the sense that, absent government moral hazard, compensation for a taking will not be linked to market value.

In this setting, the takings decision is governed by (5). Given the compensation rule $K(\theta x) = a + b\theta x$, the logger's optimal investment decision is given by,

$$\arg\max_x \int_{\theta_0}^{\theta_1}\int_{\beta_0}^{sx} sxh(t)f(s)dtds + \int_{\theta_0}^{\theta_1}\int_{sx}^{\beta_1}(a+bsx)h(t)f(s)dtds + g(1-x),$$

or, equivalently, by the solution to

$$\begin{aligned}\int_{\theta_0}^{\theta_1}\int_{\beta_0}^{sx} sh(t)f(s)dtds - g'(1-x) + \\ \int_{\theta_0}^{\theta_1} s(sx^2 - a - bsx^2))h(sx)f(s)ds + \\ \int_{\theta_0}^{\theta_1}\int_{sx}^{\beta_1} bsh(t)f(s)dtds = 0\end{aligned} \tag{7}$$

Suppose that the compensation schedule sets $b = 0$ and

$$a = x^* \frac{\int_{\theta_0}^{\theta_1} s^2 h(sx^*)f(s)ds}{\int_{\theta_0}^{\theta_1} sh(sx^*)f(s)ds}. \tag{8}$$

Then it is straightforward to see that the unique solution to equation (7) is $x = x^*$. Hence, the first-best allocation, described by (5) and (6), can be achieved without having compensation depend upon market value. In practice, this compensation rule might be problematic to implement because the efficient level of investment, x^*, and the distribution of productivities must be common knowledge. That being said, we emphasize that the point of this section is to simply demonstrate that the basic structure of our model is similar to other models in the literature and we can draw the same conclusions with respect to market value compensation.

The intuition behind the compensation rule given by (8) and $b = 0$ is simple. Suppose that $a = b = 0$. In addition to increasing output, an increase in investment increases the private value of tree planting which implies that the probability of land being taken is reduced. This provides an added element to the return to investment for the logger and, hence, will result in overinvestment. This incentive to overinvest is, however, offset by every dollar of lump sum compensation that is paid in the event of taking and the lump sum given by (8) completely offsets the incentive to overinvest.[8]

Our result is consistent with BRS in showing that first best can be achieved with compensation that is independent of market value. It contrasts, however, with BRS in showing that the lump sum compensation is not arbitrary and, importantly, that $a \neq 0$. The difference in results can be explained by the fact that in our model—and in contrast to BRS—private investment affects the probability of taking. This in turn introduces an incentive to overinvest and, hence, the need to offset this through a specific lump sum payment.[9]

5 No Government Moral Hazard, Investment Affects Alternative Value

In this section we continue to assume the absence of government moral hazard but depart from the assumption that the alternative value of land is independent of the level of private investment x.

In order to make our point most clearly we simplify by assuming that β has a two point distribution over the set $\{0, \beta_1\}$, with $h(\beta) > 0$ for $\beta \in \{0, \beta_1\}$ and $h(\beta) = 0$ otherwise. We now denote alternative private value of land as $\gamma(\beta, x)$, where the value depends upon both the campers "base private valuation", β, and the level of tree

[8]The compensation rule is not unique. For example, for any b, $0 \leq b \leq 1$, there exists an a that can implement the first-best. Intuitively, an increase in b increases the incentive to (over)invest while increasing a offsets this effect.

[9]We can show that the BRS result is a special case of our analysis. The intuition of this can be seen by examining the first order condition (7). The second term of this condition reflects the marginal benefit of decreasing the probability of a taking by increasing investment. In a model where the taking decision is independent of the level investment, as in BRS, this middle term is not present. Inspection of (7) a*bsent the middle term* reveals that the first best level of investment is implemented if b is set equal to zero. This is effectively the BRS result.

planting, x. We assume that $\gamma(\beta, 0) = \beta$, $\gamma(0, x) = 0$ and $\gamma(\beta_1, x) > \theta_1 \;\; \forall \; x \in [0, 1]$. These assumptions imply that the level of tree planting, x, does not affect the takings decision. Private investment will be "beneficial" to the alternative value of land if $\gamma_x > 0$ and will not be if $\gamma_x < 0$.

We begin by characterizing the first best allocation for this economy. The social planner will take land when $\beta = \beta_1$. Hence, the first best level of investment is given by

$$\arg\max_{\{x\}} \quad h(0) \int_{\theta_0}^{\theta_1} sxf(s)ds + h(\beta_1)\gamma(\beta_1, x) + g(1 - x), \tag{9}$$

or, equivalently, by the solution to

$$h(0) \int_{\theta_0}^{\theta_1} sf(s)ds + h(\beta_1)\gamma_x(\beta_1, x) - g'(1 - x) = 0. \tag{10}$$

Note that the term $h(\beta_1)\gamma_x(\beta_1, x)$ in this equation reflects the effect that tree planting has on the alternative private value.

The level of investment chosen by the logger reflects both the taking decision of the social planner and the compensation rule $K = a + b\theta x$. The level of tree planting that the logger chooses is given by the solution to

$$h(0) \int_{\theta_0}^{\theta_1} sf(s)ds + h(\beta_1) \int_{\theta_0}^{\theta_1} bsf(s)ds - g'(1 - x) = 0. \tag{11}$$

Comparing (11) with (10) reveals that if

$$b = \frac{\gamma_x(\beta_1, x^*)}{\int_{\theta_0}^{\theta_1} sf(s)ds} \equiv \hat{b},$$

then the first-best level of investment will be achieved. Therefore, the optimal compensation schedule is given by $K = a + \hat{b}\theta x$, where a can take on any value.

The link between market value and compensation induces the logger to internalize the social value of private investment. On the other hand, the lump sum component of this compensation rule can take on any value for the same reason that it does in BRS since the two point distribution does not affect the probability of a taking.

6 Government Moral Hazard, Only Campers Matter

In this section we assume that $\omega = 0$ in (1). Here, the government will take the logger's property rights whenever the private alternative benefit of doing so exceeds compensation, i.e., whenever $\beta \geq a+b\theta x$. Hence, the logger's optimal amount of tree planting is given by

$$\arg\max_x \int_{\theta_0}^{\theta_1}\int_{\beta_0}^{a+bsx} sxh(t)f(s)dtds + \int_{\theta_0}^{\theta_1}\int_{a+bsx}^{\beta_1}(a+bsx)h(t)f(s)dtds + g(1-x),$$

or, alternatively, is given by the solution to,

$$\int_{\theta_0}^{\theta_1}\int_{\beta_0}^{a+bsx} sh(t)f(s)dtds - g'(1-x)+$$

$$\int_{\theta_0}^{\theta_1}\left(bs^2x - abs - b^2s^2x\right)h(a+bsx)f(s)ds + \int_{\theta_0}^{\theta_1}\int_{a+bsx}^{\beta_1} bsh(t)f(s)dtds = 0. \quad (12)$$

In this setting the planner's problem is given by

$$\max_{\{a,b,x\}} \int_{\theta_0}^{\theta_1}\int_{\beta_0}^{a+bsx} sxh(t)f(s)dtds + \int_{\theta_0}^{\theta_1}\int_{a+bsx}^{\beta_1} th(t)f(s)dtds + g(1-x),$$

subject to constraint (12). The first order conditions for the planner's problem with respect to a, b, and x are, respectively,

$$\int_{\theta_0}^{\theta_1}\left(sx-a-bsx\right)h(a+bsx)f(s)ds + \lambda\left(\int_{\theta_0}^{\theta_1}\left(s-2bs\right)h(a+bsx)f(s)dsx)f(s)ds\right) = 0 \quad (13)$$

$$\int_{\theta_0}^{\theta_1}\left(s^2x^2 - asx - bs^2x^2\right)h(a+bsx)f(s)ds+$$

$$\lambda(\int_{\theta_0}^{\theta_1}\left(2s^2x - as - 3bs^2x\right)h(a+bsx)f(s)ds + \int_{\theta_0}^{\theta_1}\int_{a+bsx}^{\beta_1} sh(t)f(s)dtds) = 0, \quad (14)$$

and

$$\int_{\theta_0}^{\theta_1}\int_{\beta_0}^{a+bsx} sh(t)f(s)dtds - g'(1-x) + \int_{\theta_0}^{\theta_1}\left(xbs^2 - abs - b^2s^2x\right)h(a+bsx)f(s)ds+$$

$$\lambda(\int_{\theta_0}^{\theta_1}\left(2s^2b - 2b^2s^2\right)h(a+bsx)f(s)ds + g''(1-x)) = 0, \quad (15)$$

where λ is the multiplier associated with constraint (12). The following proposition demonstrates that compensation will depend on market value.

Proposition 1 *When the government only cares about the camper's welfare, the optimal compensation rule will depend upon the market value, i.e.,* $b \neq 0$.

Proof: Assume the contrary, i.e., that $b = 0$. Equation (12) becomes,

$$\int_{\theta_0}^{\theta_1}\int_{\beta_0}^{a} sxh(t)f(s)dtds = g'(1-x), \quad (16)$$

and equation (15) becomes

$$\int_{\theta_0}^{\theta_1} \int_{\beta_0}^{a} sxh(t)f(s)dtds = g'(1-x) - \lambda g''(1-x). \tag{17}$$

Equations (16) and (17) imply that $\lambda = 0$, i.e., if compensation is not linked to market value, then the investment distortion constraint (12) is not binding. If $b = \lambda = 0$, then equation (13) implies that the lump sum compensation is equal to the expected market value,

$$a = xE(\theta),$$

where $E(\theta) \equiv \int_{\theta_0}^{\theta_1} sf(s)ds$, and equation (14) implies that

$$a = \frac{xE(\theta^2)}{E(\theta)}.$$

But since $E(\theta^2) \neq (E(\theta))^2$, the lump sum payment a (with $b = 0$) can not satisfy both of these equations, a contradiction. Therefore, it can not be that $b = 0$. $\square$

The implication of Proposition 1 is that market value is an important tool in aligning the interests of the logger and the government with that of the social planner. The intuition behind Proposition 1 is that, when the government is concerned only with the welfare of the camper, he must be induced to internalize the cost of foregone output, θx, and this can only be achieved by making the compensation schedule depend upon θx. To see this, suppose that b is set to zero and $a > 0$. In this case, the government will take whenever $\beta > a$, independent of the value of lost output. But an efficient taking decision requires a comparison of θx with β. When $b \neq 0$, the government's decision will reflect a measure of foregone output via the compensation schedule and, thus, "improves" the takings decision. The optimal compensation rule will have $a \geq 0$ and $0 < b < 1$. Thus having $a > 0$ and $0 < b < 1$: (i) improves the "overinvestment problem" compared to a compensation scheme that specifies $a = 0$ and $b = 1$ and (ii) improves the *ex post* takings decision compared to a compensation rule that specifies $a > 0$ and $b = 0$.

7 Government Moral Hazard, Only Loggers Matter

In this section we assume that $\omega = 1$ in (1). The preferences of the government now imply that land will be taken whenever $a + b\theta x \geq \theta x$. It turns out that the optimal compensation rule will take one of two forms: Either $a = 0$ and $b = 1$ or $a > 0$ and $b = 0$. That is, either compensation will be equal to market value or independent of market value. When $a = 0$ and $b = 1$, the government will be indifferent between taking or not. But according to assumption A, the government will make the socially optimal taking decision and, therefore, compares market value with the alternative value of the land. However, when $a > 0$ and $b = 0$ the alternative value of land does not come into play for the takings decision. The social planner will select the compensation rule, i.e., either $a = 0$ and $b = 1$ or $a > 0$ and $b = 0$, which delivers the highest level of social welfare.

7.1 Compensation Rule: $b = 1$

It turns out that when $b = 1$ it will never be optimal to have $a \neq 0$. First note that, independent of the value of a, if $b = 1$,the level of tree planting by the logger, $\hat{x}$, solves

$$\int_{\theta_0}^{\theta_1} sf(s)ds - g'(1-x) = 0. \tag{18}$$

If $a < 0$, then the government will never take land; if $a > 0$, then the government will always take land. Both of these takings policies are inefficient. In contrast, when $a = 0$, the government is indifferent between taking and not and, by assumption A will make the efficient takings decision. If the social planner chooses $a = 0$ and $b = 1$, then expected social welfare, $SW^c(a = 0, b = 1)$, will be

$$SW^c(a=0,b=1) = \int_{\theta_0}^{\theta_1}\int_{\beta_0}^{s\hat{x}} s\hat{x}f(s)h(t)dtds + \int_{\theta_0}^{\theta_1}\int_{s\hat{x}}^{\beta_1} tf(s)h(t)dtds.$$

Note that there is an overinvestment in tree planting, i.e., compare equation (18) with the equation that describe the socially optimal level of investment, (6).

7.2 Compensation Rule: $b \neq 1$

When the government cares only about the logger it will take whenever $a + b\theta x \geq \theta x$ or when,

$$\theta \leq \frac{a}{(1-b)x}.$$

This implies that the logger's optimal level of tree planting will be

$$\arg\max_x \int_{\frac{a}{(1-b)x}}^{\theta_1} sxf(s)ds + \int_{\theta_0}^{\frac{a}{(1-b)x}} \big(a + bsx\big)f(s)ds + g(1-x),$$

or, alternatively, is given by the solution to,

$$\int_{\frac{a}{(1-b)x}}^{\theta_1} sf(s)ds + \int_{\theta_0}^{\frac{a}{(1-b)x}} bsf(s)ds - g'(1-x) = 0. \tag{19}$$

Hence, the social planner's problem is given by

$$\max_{\{a,b,x\}} \int_{\frac{a}{(1-b)x}}^{\theta_1} sxf(s)ds + \int_{\beta_0}^{\beta_1} \int_{\theta_0}^{\frac{a}{(1-b)x}} th(t)f(s)dsdt + g(1-x), \tag{20}$$

subject to (19). The first order conditions (with respect to a and b) are,

$$-\frac{a}{(1-b)^2x} + \frac{\int_{\beta_0}^{\beta_1} th(t)dt}{(1-b)x} + \lambda\Big(-\frac{a}{(1-b)^2x^2} + \frac{ba}{(1-b)^2x^2}\Big) = 0 \tag{21}$$

and

$$-\frac{a}{(1-b)^2x} + \frac{\int_{\beta_0}^{\beta_1} th(t)dt}{(1-b)x} + \lambda\Big(-\frac{a}{(1-b)^2x^2} + \frac{ba}{(1-b)^2x^2} + \frac{(1-b)}{af(\frac{a}{(1-b)x})} \int_{\theta_0}^{\frac{a}{(1-b)x}} sf(s)ds\Big) = 0, \tag{22}$$

where λ is the multiplier associated with constraint (19). Note that equation (21) is identical to the first four terms of equation (22). This means that if $a/((1-b)x) > \theta_0$,[10] then last term in (22) is strictly positive and both equations (21) and (22) can only hold if $\lambda = 0$.

The planner's constraint (19) will not bind, i.e., $\lambda = 0$, if the logger's investment decision coincides with what the planner would pick. The planner would choose the level of investment, $\tilde{x}$, that solves

$$\int_{\frac{a}{(1-b)x}}^{\theta_1} sf(s)ds - g'(1-x) = 0. \tag{23}$$

Comparing (19) with (23), the decisions coincide only if $b = 0$. Substituting $\lambda = 0$ and $b = 0$ into either equation (21) or (22) we arrive at $a = E(\beta)$, where $E(\beta) = \int_{\beta_0}^{\beta_1} th(t)dt$. If the social planner chooses $a = E(\beta)$ and $b = 0$, then the expected social welfare, $SW^c(a = E(\beta), b = 0)$, will be

$$SW^c(a = E(\beta), b = 0) = \int_{\frac{E(\beta)}{\tilde{x}}}^{\theta_1} s\tilde{x}f(s)ds + \int_{\beta_0}^{\beta_1} \int_{\frac{E(\beta)}{\tilde{x}}}^{\theta_1} tf(s)h(t)dtds.$$

[10] If $a/((1-b)x) \leq \theta_0$, then the government will never take since the region over which the government takes is $[\theta_0, a/((1-b)x)]$. If the government never takes, then the level of tree planting is given by (18). But in this situation the social planner will strictly prefer a compensation rule that specifies $a = 0$ and $b = 1$.

7.3 The Optimal Compensation Rule

The above analysis shows that the social planner need only consider two possible compensation rules: either ($a = 0$, $b = 1$) or ($a = E(\beta)$, $b = 0$). The social planner's decision will be determined by comparing $SW^c(a = E(\beta), b = 0)$ with $SW^c(a = 0, b = 1)$: If $SW^c(a = 0, b = 1) \geq SW^c(a = E(\beta), b = 0)$, then social planner will chose $a = 0$ and $b = 1$ in the compensation rule; otherwise the social planner will choose $a = E(\beta)$ and $b = 0$.

We have shown that the social planner will either choose to impose a market value based compensation rule or one that is independent of market value. A natural question to ask is whether or not there are any parameter values that imply that market value will be used. If the expected alternative value is less than or equal to the logger's minimum output under the lump sum compensation rule, i.e., if $E(\beta) \leq \theta_0 \tilde{x}$, then the government will never take. In this situation market value compensation will dominate because it gives the same level of investment in tree planting but delivers an efficient takings decision.

We may summarize the analysis and discussion contained in this section in the following proposition,

Proposition 2 *If the government cares only about the logger's welfare, then the optimal compensation will be a payment that is equal to either the expected alternative private value, $E(\beta)$, or market value, θx. If $E(\beta) \leq \theta_0 \tilde{x}$, then the optimal compensation will be equal to the market value. By continuity, if $\theta_0 \tilde{x} > E(\beta)$ and is in the neighborhood of $E(\beta)$, then the optimal compensation will be equal to market value.*

8 Summary and Conclusions

The BRS study presents an elegant and compelling case for a simple and easily implementable compensation rule: Compensation should be zero. But in the presence of government moral hazard we have shown that market value will generally be an important factor in the compensation rule.

On the one hand, the sensitivity of the compensation rule to political influence suggests that it is dangerous to leave the compensation rule up to the government of the day. We show how welfare is improved by committing the government to a rule that forces recognition of factors they would rather ignore.

On the other hand, however, our analysis indicates how difficult the task of pre-specifying a compensation rule actually is. In particular, the specific link between market value and compensation is not simple as it depends on the social value of private investment, the specific form of the production functions, the nature of technological uncertainty, the preferences of the government and, possibly, the socially efficient levels of investment. Clearly, from a practical point of view, it would be extremely difficult to enshrine a compensation rule into a constitution that depended upon preferences, technology, etc. What then, *from a practical point of view*, does our analysis imply for a compensation rule?

We can think of few cases where the government grants property rights when there is a high probability that these rights will be taken. Instead, governments seem to retain these property rights or, perhaps, leases them, but does not sell them. This suggests that the most relevant cases are those where the *ex ante* probability of a taking is "low." Hence, based on our analysis, consideration of the practical difficulty of implementing various compensation schemes and the observation that the *ex ante* probability of a taking is low, we feel that market value compensation is best for a number of reasons.

First, we can argue that when the probability of property being taken is relatively low, market value compensation is attractive. This view reflects two of our results. When governments favor property owners, we have shown that market value is optimal when the expected alternative private value is "low." Low *expected* alternative private value implies that there is a relatively high probability that a low alternative private value will be observed. Hence, for a given market value, a low expected alternative private value is associated with a relatively low probability of a taking. On the other hand, when governments favor campers, the optimal compensation is a lump sum plus a percentage of the market value. However, when the probability of a taking is small, the lump sum component, a, becomes small and the fraction of market value, b, approaches one. Hence, even here the optimal compensation will not be significantly different from market value compensation.

Second, as mentioned above, when compensation is lump sum, implementation generally requires foreknowledge of optimal production, investment, etc. As a practical matter, it is not obvious that governments have the ability to assess optimal production for private firms. We have shown that the difference between market value and the optimal compensation becomes small as the probability of a taking is small. Hence, for cases where there is a small *ex ante* chance of a taking, market value compensation is an easily implementable scheme that has relatively small (welfare) costs associated with it.

Third, our analysis assumes that the constitution is designed with perfect knowledge of who the government will favor. In practice, the preferences of those in power change through the political process. Unfortunately, a constitution cannot be made contingent on the preferences of the government of the day. Therefore, it is reasonable to assume a single rule must be adopted independent of the government preferences. Since market value is optimal for some government preferences, and have relatively low cost for other preferences, it is in our view the preferred choice.

In this study we consider the role of compensation rules in both private investment decisions and government decisions. The novel feature of our analysis is an allowance for politically motivated implementation that may diverge from socially optimal implementation. Previous studies have focused on investment efficiency and have concluded that compensation based on market value is inefficient. The main result of our investigation is the discovery that, in most cases, an efficient compensation schedule must reflect market value. We have demonstrated what is, we feel, intuitively obvious: Requiring decision makers to pay market value forces them to internalize economic costs that their political concerns would cause them to ignore.

9 References

Baxter, W. and L. Altree, 1972, "Legal aspects of airport noise," *Journal of Law and Economics*, 1-113.

Blume, L., D. Rubinfeld, and P. Shapiro, 1984, "The taking of land: When should compensation be paid?," *Quarterly Journal of Economics*, 71-92.

Carlson, A. and D. Pollak, 2001, "Takings on the Ground: How the Supreme Court's Takings Jurisprudence Affects Local Land Use Decisions," *U.C. Davis Law Review.*

DeAlessi, L., 1969, "Implications of property rights for government investment choices," *American Economic Review*, 13-24.

Epstein, R., 1985, *Takings, private property and the power of eminent domain.*

Fischel W. and P. Shapiro, 1988, "Takings, insurance and Michelman: Comments on economic interpretations of just compensation law," *Journal of Legal Studies*, 269-293.

Fischel W. and P. Shapiro, 1989, "A constitutional choice model of compensation for takings," *International Review of Law and Economics*, 115-128.

Grossman, G. and E. Helpman, 1994, "Protection for sale," *American Economic Review*, 833-850.

Heller, M., and J. Krier, 1999, "Deterrence and Distribution in the Law of Taking," *Harvard Law Review*, 997-1025.

Hermalin, B. 1995, "An economic analysis of takings," *Journal of Law, Economics and Organization*, 518-537.

Knetsch, J. and T. Borcherding, 1979, "Expropriation of private property and the basis for compensation," *University of Toronto Law Journal*, 237-252.

Laffant, J-J. and J. Tirole, 1993, *The theory of incentives in procurement and regulation*, The MIT Press.

Nosal, E, 2001, "The taking of land: Market value compensation should be paid," *Journal of Public Economics*, 431-443.

Rose-Ackerman, S. and J. Rossi, 2000, "Disentangling Deregulatory Takings," Florida State University College of Law working paper.

Treanor, W., 1985, The origins and original significance of the just compensation clause in the fifth amendment, *The Yale Law Journal*, 694-716.

Tullock, G., 1975, "The transitional gains trap," *The Bell Journal of Economics*, 671-678.

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